



# Agriculture and Health Nexus: Developing Country Consumers' Acceptance of Biofortified Foods

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# HarvestPlus

**An Interdisciplinary Program**  
200+ scientists, 40+ countries



Consultative Group on Int'l Ag. Research (CGIAR)



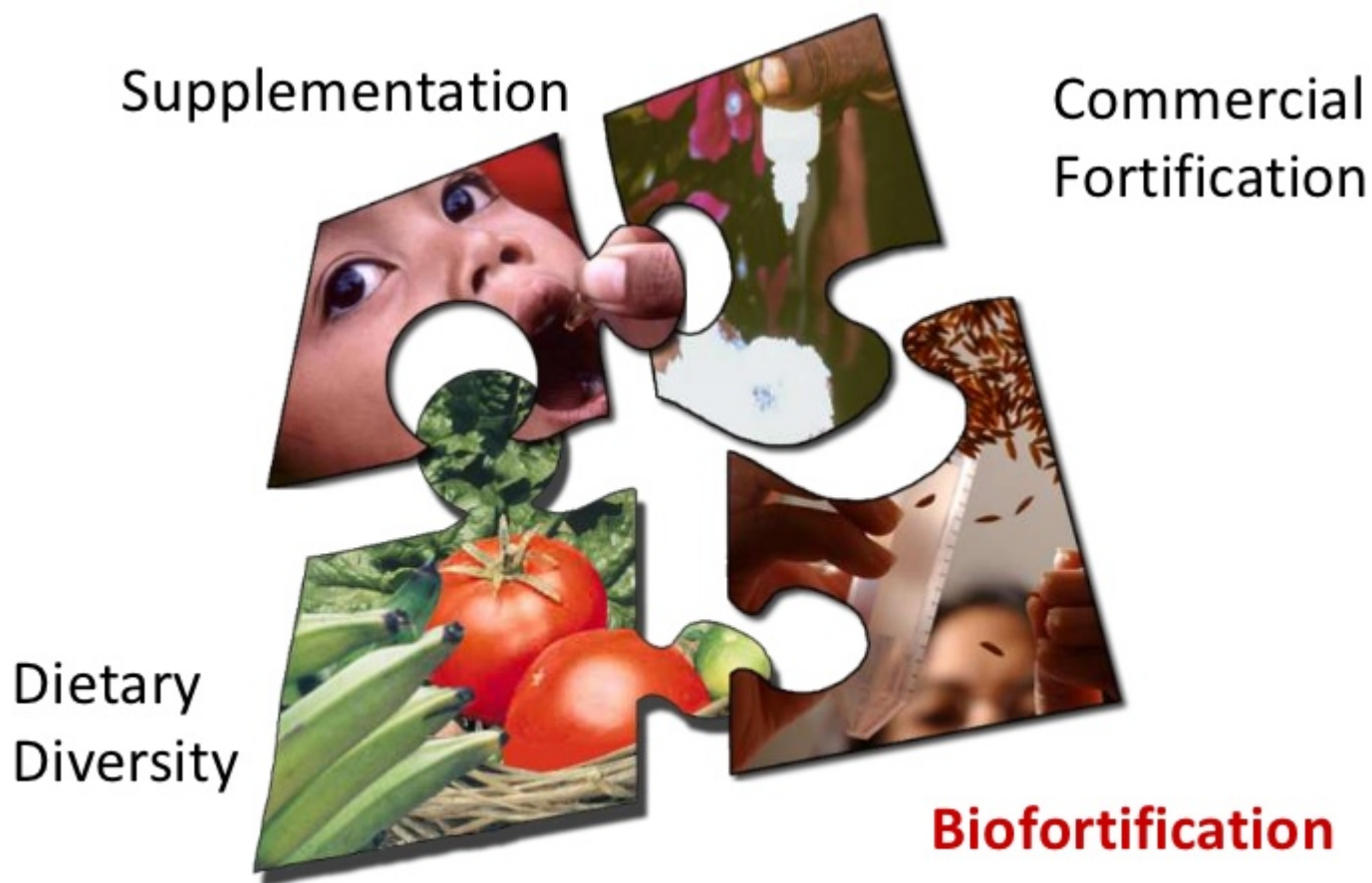
# Global Micronutrient Deficiency

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- Vitamin A deficiency is a public health problem in more than half of all countries
  - 250 million preschool children
  - 250 000 to 500 000 become blind yearly
- About 40% of preschool children in developing countries are estimated to be anaemic
- Anaemia contributes to 20% of all maternal deaths



# Approaches to hidden hunger





# Biofortification

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Biofortification-breeding food crops that are more nutritious







# Targeted

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**Targeted:** poor people eat staples





# Planting Materials

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**Sustainable:** farmers can save and share





# Asia

## Biofortified Crops for Asia



**Pearl Millet**

Iron (Zinc)

India



**Rice**

Zinc

Bangladesh, India



**Wheat**

Zinc

India, Pakistan





# Africa

## Biofortified Crops for Africa



### Cassava

Provitamin A  
DR Congo, Nigeria



### Beans

Iron  
DR Congo, Rwanda



### Maize

Provitamin A  
Zambia



### Sweet Potato

Provitamin A  
Mozambique,  
Uganda



# First Challenge

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## Nutrition Challenge

Demonstrate the ability of biofortified crops to have an **impact** on the nutritional and health status of the **target population**

Bioavailability studies

Retention studies

Efficacy trials

Impact Evaluation

Diagnostic studies

Consumer Acceptance



# REU Project

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## Reaching End Users (REU) Orange Fleshed Sweet Potato Project



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## Second Challenge

- Vitamin A crops change color due to beta-carotene content
- Will farm households prefer these crops vis-a-vis conventional varieties?
- Will target consumers in developing countries be willing to pay a premium for biofortified crops?





# Second Challenge

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## **What are the strategies to market and promote biofortified crops?**

- Should we provide nutrition information?
  - In which way? (information content: scare vs. motivational tactics, long vs. short messages)
  - How should we give the information? (Radio, community leaders)
  - At what frequency should the information be provided?
  - Should we include political leaders' endorsement?
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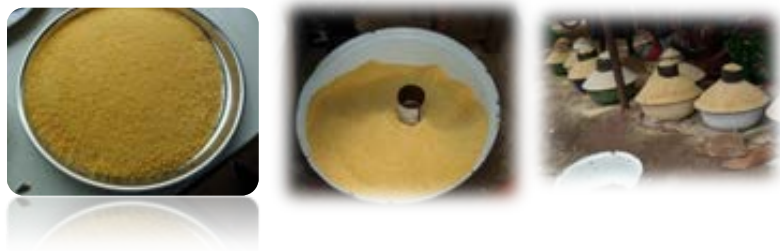
Minimize Cost | Maximize Impact  
7 Countries | 8 Studies | 5 crops



# Vitamin A Crops



**Vitamin A Orange Maize:**  
Zambia, Ghana, Nigeria



**Vitamin A Yellow Cassava:**  
Nigeria, DRC



**Orange Fleshed Sweet Potato:**  
Uganda, Mozambique





# Iron Crops

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**Cost-effective:**  
central one-time investment

**Iron Pearl Millet: India**



**Iron beans: Rwanda, DRC, Guatemala**





# Methods

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- **Experimental Economics** – Incentive compatible mechanisms such as:
  - Revealed choice experiment: real good | choice
  - BDM: real good | real money in simulated market
  - Nth price auction:  $n - 1$  highest bidder pays  $n$ th highest bid (market price)
- **Food Sciences:**
  - Hedonic testing
  - Sensory Evaluation

*Key attributes tested include color, taste, texture, aroma, cooking time, overnight keeping quality and overall liking*





# Summary of Hedonic testing & WTP Studies

Country	Biofortified food	Sample size	Test setting*	WTP method**	Treatments	Participation fee	Year
Uganda	OSP	467	CLT - Rural	RCE	Nutrition information	Given	2006
		467	CLT - Rural	HCE	Nutrition information Nutrition information and cheap talk	Given	2006
Zambia	vitamin A maize <i>nshima</i>	273	HUT - Rural	RCE	Nutrition information through simulated radio message Nutrition information through community leader	Given	2007
		205	CLT - Rural	RCE	Nutrition information through simulated radio message	Given	2007
Ghana	vitamin A maize <i>kenkey</i>	288	CLT - Rural	RCE	Nutrition information	Given - varied	2008
		128	CLT - Rural	nth price auction	Nutrition information	Given	2008
		289	CLT - Rural	BDM	Nutrition information	Given - varied	2008
Nigeria	vitamin A cassava <i>gari</i>	671	CLT - Rural	BDM	Nutrition information and delivery by federal authority Nutrition information and delivery by international authority	Not given- out of pocket payment	2011
India	Iron pearl millet <i>bakhri</i>	452	CLT - Rural	BDM	Nutrition information and state level certification and branding	Not given- out of pocket payment	2012
Rwanda	Iron beans	578	HUT - Rural	BDM	Nutrition information - short and positive Nutrition information - short, positive and endorsement Nutrition information - long positive Nutrition information - long, positive and endorsement	Not given- out of pocket payment	2013
		572	HUT - Rural	BDM	Nutrition information - motivate, listen once Nutrition information - motivate, listen thrice Nutrition information - scare, listen once Nutrition information - scare, listen thrice	Not given- out of pocket payment	2013
		399	CLT - Urban retail market	BDM	Nutrition information - motivate Nutrition information - scare	Not given- out of pocket payment	2013
		261	CLT - Urban wholesale market	BDM	Nutrition information	Not given- out of pocket payment	2013
Guatemala	Iron beans	360	HUT - Rural	BDM	Nutrition information - listen once Nutrition information - listen thrice	Not given- out of pocket payment	2013



# WTP/Premium Estimations

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- Simple difference
  - OLS/D-I-D
  - Random parameter logit model
  - Conditional logit model
  - Random effect GLS/Tobit model
  - Interval censored model
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- Accounted for: nonpayment, lexicographical preferences, endowment effect, convergent validity between RCE & experimental auction, etc.



# Summary of Hedonic Testing Results

Country	Biofortified food	Control hedonic comparison of food products	Treatment hedonic comparison of food products
Uganda	OSP	OSP preferred to local varieties	No additional effect
Zambia	vitamin A maize <i>nshima</i>	No difference in preferences in both HUT and CLT	Vitamin A maize preferred in both HUT and CLT
Ghana	vitamin A maize <i>kenkey</i>	Variation in preferences across districts	No additional effect
Nigeria	vitamin A cassava <i>gari</i>	<b>Local preferred in Imo and light yellow vitamin A cassava preferred in Oyo</b>	Deep yellow preferred in Imo and both vitamin A cassava varieties preferred in Oyo
India	Iron pearl millet <i>bakhri</i>	Iron pearl millet preferred to local varieties	Preference for iron pearl millet increases No difference of certification and branding authority
Rwanda	Iron beans	<b>One iron bean variety is preferred to local and local is preferred over another iron bean variety</b>	Overall increased preference for iron beans, effect size and significance differs across treatments
Guatemala	Iron beans	Iron bean preferred	No additional effect



# Summary of WTP Results (1)

Country	Biofortified food	Control WTP for biofortified products	Treatment WTP for biofortified products	Effect of treatment
Uganda	OSP	No significant difference	25% premium for OSP compared to white local variety	Information: Yes
Zambia	vitamin A maize <i>nshima</i>	No significant difference	8-23% (depending on the test setting, information source and estimation model) premium for vitamin A maize compared to white local	Information: Yes Source of Information: Yes
Ghana	vitamin A maize <i>kenkey</i>	15-20% discount for vitamin A maize compared to white local variety	25-50% (depending on WTP method) premium for vitamin A maize compared to white local variety	Information: Yes
Nigeria	vitamin A cassava <i>gari</i>	In Imo state 14-28% (depending on variety) discount for vitamin A cassava compared to local  In Oyo state 9% discount to 6% premium (depending on variety) for vitamin A cassava compared to local	In Imo state 10-19% (depending on variety and delivery method) premium for vitamin A cassava products compared to local variety  In Oyo state 20-28% (depending on the variety and delivery method) premium for vitamin A cassava products compared to local	Information Yes: Planting Material Delivery method: No





# Summary of WTP Results (2)

Country	Biofortified food	Control WTP for biofortified products	Treatment WTP for biofortified products	Effect of treatment
India	Iron pearl millet <i>bakhri</i>	6% premium for iron pearl millet compared to local	29-32% (depending on the certification authority and branding) premium for iron pearl millet compared to local	Information: Yes Certification authority: Yes Branding type: Yes
Rwanda	Iron beans	In rural areas, 13% discount to 8% premium (depending on the variety and location) for iron beans compared to local In urban area, 10% premium for iron beans compared to local	In rural area, 9-17% (depending on information content, frequency and length) premium for iron beans compared to local In urban area, 6-20% (depending on the variety and information content) premium for iron bean compared to local	Information: Yes Information Frequency: Yes Information Length: No Scare vs. Motivate Info: No District Officer's Endorsement: No
Guatemala	Iron beans	No significant difference	No significant difference	Information: No Information Frequency: No



# Key Message

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- **Biofortification** is a promising & potentially cost-effective solution to micronutrient deficiency in developing countries
- **Impact:** consumption of vitamin A orange fleshed sweet potato increases total vitamin A intake among women and children in Uganda and Mozambique
- **Acceptance:**
  - (1) In several cases, biofortified varieties are preferred to local varieties even without information,
  - (2) Nutrition information is key (effect size: 5 – 34%)



# Key Message

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- **Breeding**

- Experimental field production data + sensory evaluation (consumption) data are pivotal to most recent crop releases

- **Targeted Delivery, Marketing & Promotion are required**

*Context specific implications for crop development, marketing and delivery activities*

- Dissemination: Which region? partner? What branding work?
- In Zambia: it is potentially less costly to go with radio
- In Rwanda: Repeated messaging increases impact & reduces discount for the white bean variety by 84%
- Endorsement by local political leader - not significant



# We thank you!!

